Science Model Lesson

Grade 10

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The Fishy Food Web of the Flathead
Approximate Duration: 200 minutes

Stage 1 Desired Results

Established Goals

Science Standard 3: Students … demonstrate knowledge of characteristics, structures, processes and function of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

Essential Understanding 4: Reservations are lands that have been reserved by the tribes for their own use through treaties, statutes, and executive orders and were not "given" to them. The principle that land should be acquired from the Indians only through their consent with treaties involved three assumptions:

I. Both parties to treaties were sovereign powers.
II. Indian tribes had some form of transferable title to the land.
III. Acquisition of Indian lands was solely a government matter not to be left to the individual colonists.

Understandings	Essential Questions
- Introduced species have affected the food web of Flathead Lake. - All species in the lake are part of the ecosystem and are connected through the food web. - That the Confederated Salish and Kootenai Tribes (CSKT) manages fish harvest by setting fishing limits and seasons, the same as the state of Montana.	- How do species in the lake interact with each other? - How can one introduced species have an impact on a large and complex ecosystem? - How and why is the CSKT managing the fishery of Flathead Lake?

Students will be able to…	*Students will know…*
- List 11 common fish in Flathead Lake. - construct and explain a food web of Flathead Lake. - explain the impacts of a specific hypothetical introduction or loss of a species to the ecosystem.	- Key Terms: producer, consumer, primary consumer, secondary consumer, tertiary consumer, autotroph, heterotroph. - how the introduction of mysis shrimp impacted the food chain of Flathead Lake. - many common species of fish were introduced to Flathead Lake.

Stage 2 Assessment Evidence

Performance Tasks
- Explain how introduced species have affected the ecology of Flathead Lake, and how future introductions can be dangerous to this and other ecosystems.
- Explain how the Confederated Salish and Kootenai Tribes are managing the fishery of Flathead Lake to restore bull trout. For background information, please access http://www.cskt.org/tr/index.htm.
- Construct a food web of Flathead Lake.

Other Evidence
- Fish identification quiz

Stage 3 Learning Plan

Day 1
1. Read Understandings from Stage 1, which should be posted on the board.
2. Warm up:
    - Pass out a copy of the Montana fishing regulations. (These are free and can be obtained by any vendor of fishing licenses; you may also access them at http://fwp.mt.gov/fishing/regulations/default.html).
    - Have the students locate the coldwater species on the inside front cover and the next subsequent pages. Ask them what information they can learn from these pages. What part of the state are these coldwater species found? Why are the coldwater species found predominantly in the western part of the state? How many native and non-native species are there? How did the non-native fish get there?
    - Have the students also locate the warm water species on the inside back cover. Where are these fish mostly found, in the western or eastern part of the state?
    - As an extension, have the students find the Montana fish records in the fishing regulations.
    - Have them turn to the page with the daily limits for lake trout and whitefish. Then have students look up the special regulations for Flathead Lake, which is in the Western region. This information can be found at the Fish, Wildlife and Parks website above and at http://www.cskt.org/tr/index.htm. The limit for whitefish is 100; lake trout is 50. Why do you think the limit is so high for Flathead Lake?

3. Tell the students you want them to be able to identify 12 coldwater fish species on a quiz. To prepare for the quiz they are to prepare a "cheat sheet" on which they can draw each of the fish and use a maximum of ten words, including the name, for each. They may also use color in their sketches

Day 2
1. Engage students in a class discussion on food webs. Define producer, primary consumer, secondary consumer, tertiary consumer, autotroph, heterotroph, and trophic levels.
2. As a class, create a food web together on the board.
3. Once students have a clear understanding of food webs, distribute the handout, "The Food Web of Flathead Lake." Have the students work in pairs to complete questions 1 through 4. Students may need help with the graphing assignment. They may need to be instructed to use the E*xcel spreadsheet, creating* columns for the data, and then to highlight the columns to create a line graph.

Day 3
1. Students need the handouts and graphs from the day before. Call on teams to report their observations relating to questions 2 and 3. Ask students to make a hypothesis about what is causing the population fluctuations.
2. Ask students to create a food web that will explain the fluctuations. Give them 15 minutes to complete this task.
3. Have each team share/explain the food web that they created.
4. Explain to the class what really happened to cause the changing populations. There is a place on their work sheet to record the explanation. Ask them to create a revised food web on a new sheet.
5. Discuss other scenarios. For example, what would happen if sharks were introduced? Cladocerans eat phytoplankton, which are microscopic plants that float around in the water and are the producers. What would happen if fertilizer was added to the water?

Day 4
1. Return to the fishing regulations and answer the question posed during warm up: The limit for whitefish is 100; lake trout is 50. Why do they think the limit is so high for Flathead Lake?
2. Tell the students about Mac Days at Flathead Lake, which is another tool the tribes use to reduce the number of lake trout. See pictures and info online at www.mackdays.com Also, please access http://www.cskt.org/tr/index.htm for further information.
6. Allow students a few moments to review their fish identification, food web terminology and then give them the quiz.

Resources
Background information for the teacher: "Shrimp Stocking, Salmon Collapse, and Eagle Displacement." Craig N. Spencer, B Riley McClelland, and Jack A. Stanford. BioScience Vol. 41 No.1.-
http://scholarworks.umt.edu/biosci_pubs/292/

Montana Fishing Regulations- http://fwp.mt.gov/fishing/regulations/default.html
Confederated Salish & Kootenai Tribes' Tribal Resources Pages found at- http://www.cskt.org/tr/index.htm
Mack Days website- http://www.mackdays.com/
Access to a computer with a graphing program, or graph paper to create a graph manually.

Biology   **The Food Web of Flathead Lake**

Data:
Use the data below to create a graph.
Graph the data, using *Excel*.

Selected Population Data

Years	Bald Eagle	Salmon x 1000	Lake Whitefish	Lake trout	Bull trout	Cutthroat Trout	Shrimp #/m2	Cladocera #/L
1979	525	67	67	0	0	0	0	2
80	364	49	0	0	0	0	0	3
81	644	108	0	0	3	.1	0	4
82	322	30	3	0	0	0	0	2
83	259	33	0	0	2	0	.3	4
84	616	90	2	0	0	0	3	4
85	525	123	0	0	0	0	49	2
86	210	25	0	0	0	0	129	2
87	70	.5	0	0	0	0	108	0
88	56	0	0	0	0	0	53	0
89	25	0	0	0	0	0	27	0
90	21	.2	0	0	0	0	37	0
91	21	0	8	8	0	0	16	0
92	14	0	2	2	.5	0	28	0
93	7	0	1	1	.1	0	19	0
94	0	0	3	3	.2	0	26	0
95	0	0	1	1	0	0	42	0
96	0	0	1	1	.1	0	41	0
97	0	0	2	2	.2	0	68	0

**Read the article "Shrimp Stocking, Salmon Collapse, and Eagle Displacement"
(http://scholarworks.umt.edu/biosci_pubs/292/)
 and use your graph to answer the following questions.**

1. What species have disappeared?

    What happened?

2. What species have appeared or increased?

    What happened?

3. Working as a team of two, create a food web that could explain why some species have disappeared.

4. Access the Fish, Wildlife and Parks Field Guide to view images of species discussed within the article

    as needed- http://fieldguide.mt.gov/displayFamily.aspx?class=Actinopterygii.

    Biology   The Food Web of Flathead Lake

    Data:
    See attached.

5. Graph the data, using the *excel* spreadsheet program.

6. What species have disappeared? Bald eagle, salmon, bull trout, cutthroat trout, cladocera.

    a.   The eagles no longer congregate in the late fall to feed off the spawning kokanee salmon as they swim up the Flathead River because the salmon are gone. The eagle population has not decreased, but has found other more scattered food sources.

    b.   The kokanee salmon disappeared because of the introduction of the *mysis* shrimp. The shrimp ate the cladocerans that the kokanee relied on, so the kokanee starved. The Kokanee did not eat the shrimp because they feed during the day in the upper water level, whereas the shrimp migrate downward in daylight hours. Other factors contributed to the kokanee decline as well, including rapidly fluctuating water levels in the lake due to Kerr dam. Rapidly lowering water levels left their eggs dry, so reproduction was unsuccessful.

    c.   Bull trout and cutthroat trout are getting eaten by lake trout. The lake trout are more successful reproducing because they grow faster and can reproduce at a younger age.

  d. This one species of cladocerans was depleted temporarily by the rapidly expanding shrimp population. Other species of cladocerans, which were faster swimmers, became the new food source.

7. What species have appeared or increased? The whitefish found the shrimp to be a wonderful food item, and their population exploded. The lake trout fed on the whitefish and shrimp, and the population increased for this reason.

8. Working as a team of two, create a food web that could explain why some species have disappeared.

Quaternary consumers
Lake trout

Tertiary consumers
Bald eagles   bull trout   cutthroat trout   lake trout

Secondary consumers
Shrimp   whitefish   kokanee salmon

Cladocerans

Primary consumers

phytoplankton

producers

Biology   Fish Population Quiz

1.   Why are the Confederated Salish and Kootenai Tribes trying to reduce the number of lake trout in Flathead Lake?

2.   Explain, using an example, how one introduced species can change the food web of the lake.

3.   What do you think would happen to the food web of Flathead Lake if a snail was introduced that feeds on algae?

Fish List: List 11 common species of fish found in Flathead Lake.

1. _____   7. _____

2. _____   8. _____

3. _____   9. _____

4. _____   10. _____

5. _____   11. _____

6. _____

Key to Fish in Flathead Lake

brook trout
brown trout
bull trout
California golden trout
kokanee salmon
lake whitefish
northern pike minnow
rainbow trout
West slope cutthroat trout
lake trout
mountain whitefish